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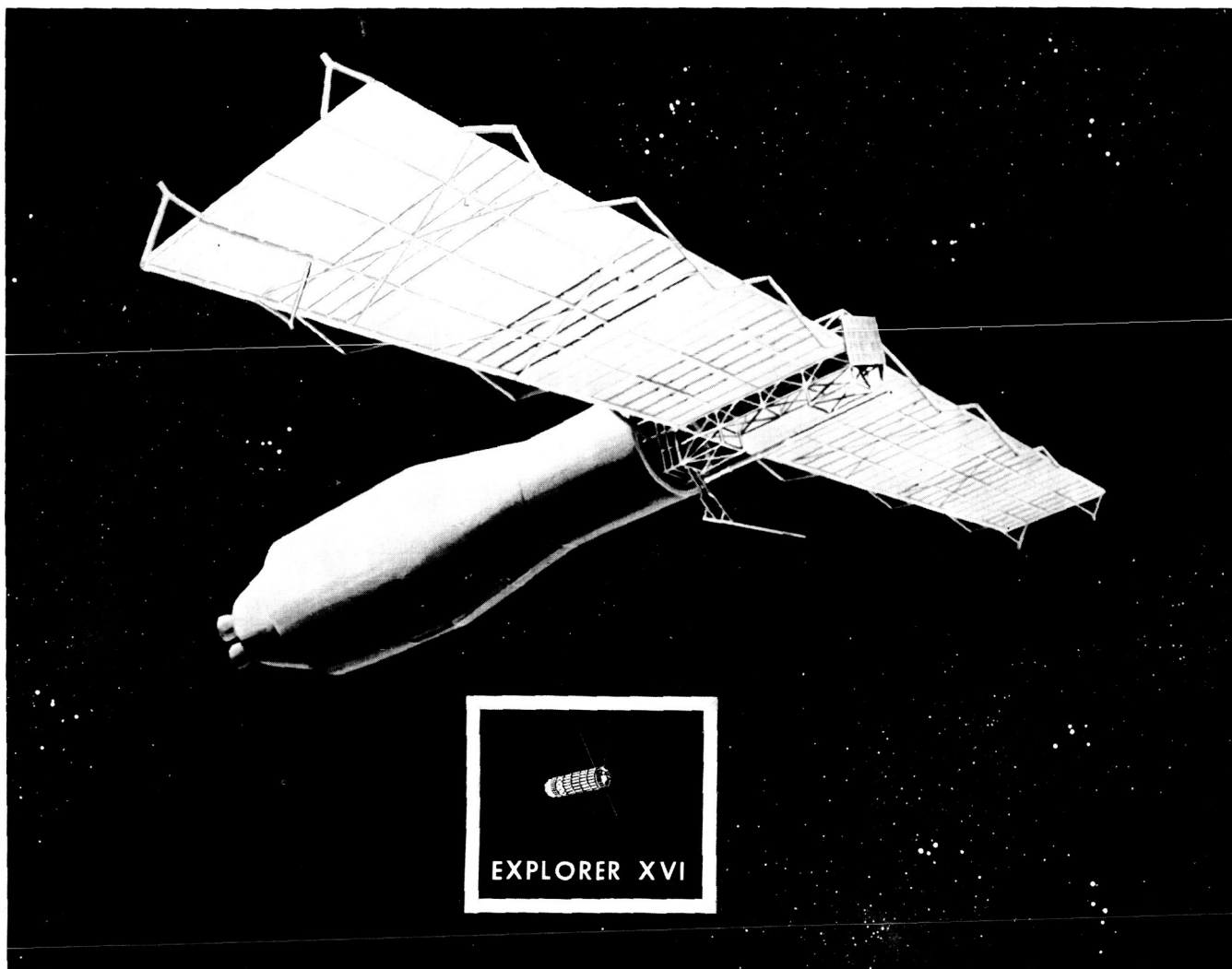
# NASA FACTS

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## PEGASUS

## N65-30685



Pegasus counts meteoroids and measures their energy. (Inset shows comparative size of Explorer XVI, an earlier meteoroid satellite.)

Pegasus collects data on the mysterious particles of matter in space called meteoroids. This satellite, named for the winged horse of Greek mythology, is one of the heaviest and largest of U.S. spacecraft.

Plans call for three Pegasus launches. Pegasus I was launched February 16, 1965, Pegasus II on May 25, 1965.

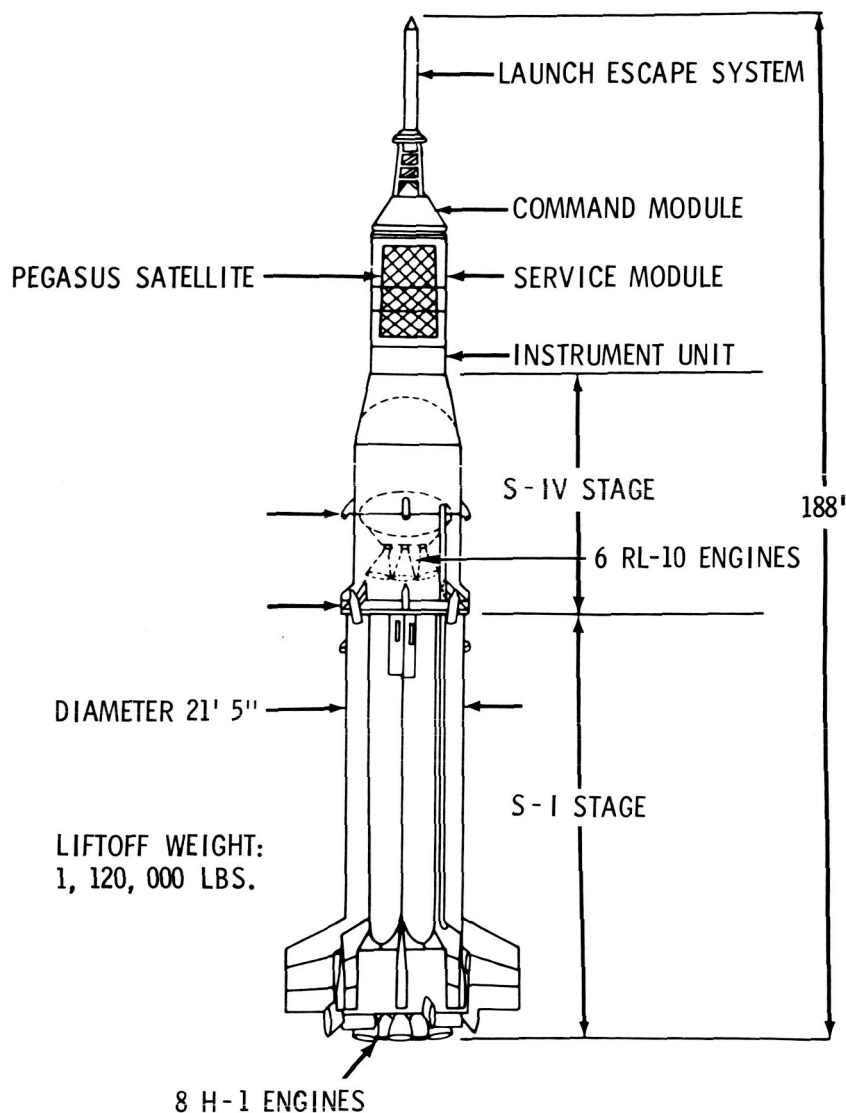
Like its namesake, the satellite is notable for its wings; however, the Pegasus spacecraft's wings are not for flying but for reporting punctures by meteoroids.

Data from Pegasus are expected not only to advance man's understanding of the space environment but also to aid him in designing large

manned and unmanned spacecraft intended for prolonged missions. For example, the depth and frequency of penetrations reported by Pega-

sus can help engineers determine how thick a spacecraft's walls must be to resist puncture by meteoroids.

### SATURN SA-9 VEHICLE



Sketch of Saturn with Pegasus payload at launch.

### NATION'S THIRD LARGEST SPACECRAFT

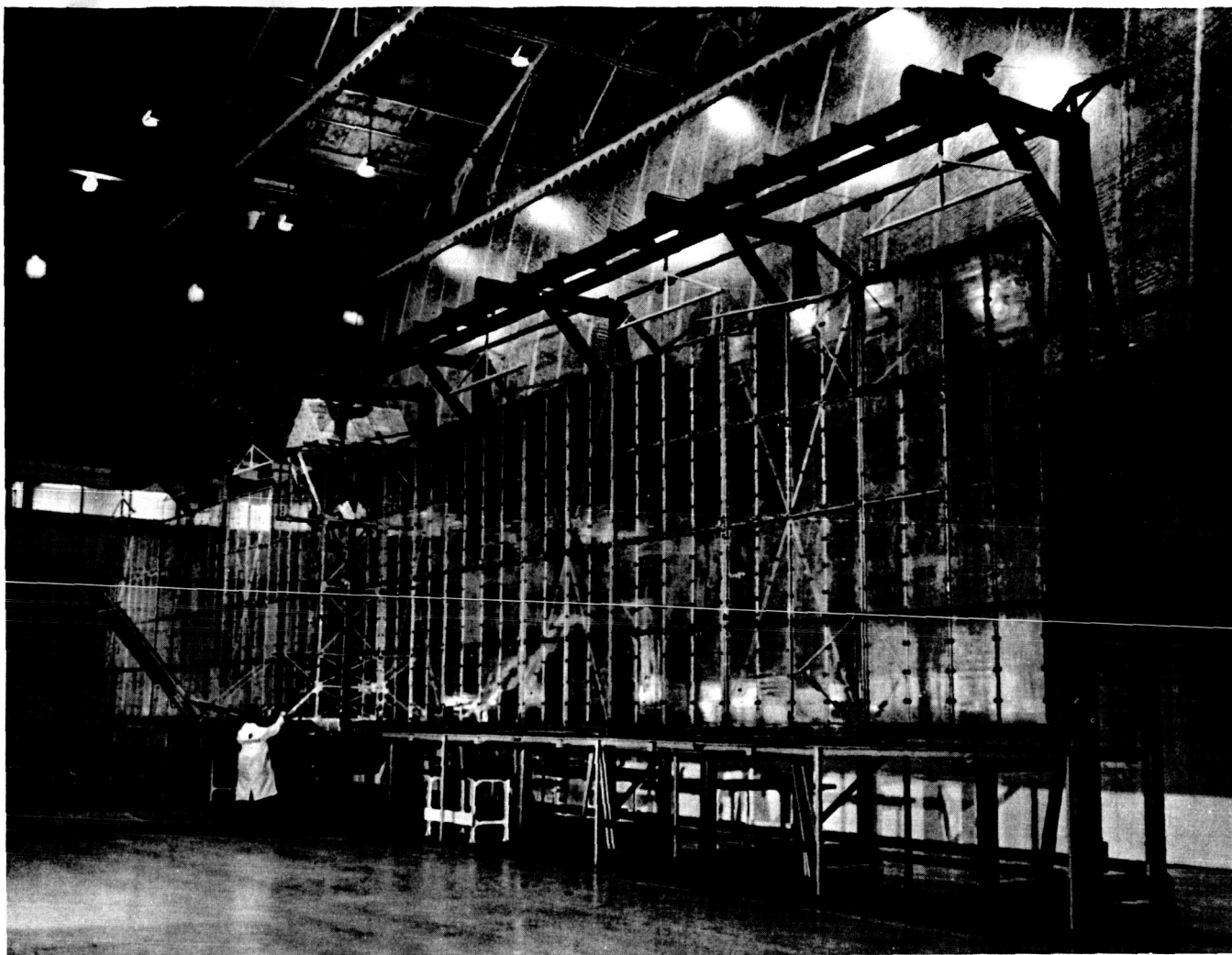
Pegasus is the Nation's third largest spacecraft. Only the 135-foot diameter Echo II and the 100-foot diameter Echo I communications satellites are larger. Both Echo satellites are balloon-like and were inflated in orbit.

Unfolded in space, the wings of Pegasus span 96 feet. The center section, resembling the fuselage of an airplane, is 71 feet long. The

length includes the attached second stage of the Saturn I rocket vehicle that launched the satellite.

Like the Echo satellites, Pegasus spacecraft are visible from earth. Pegasus satellites twinkle instead of reflecting a steady light because they "tumble" in space (turn as they move in orbit).

## WINGS REPORT METEOROID PUNCTURES



Prototype Pegasus is tested on the ground.

The 96-foot-long 14-foot-wide wings of Pegasus carry 208 panels designed to report punctures by meteoroids. Each of the two wings is made up of seven frames, hinged together, with several panels on each frame.

The upper and lower sides of each panel are covered by aluminum sheet in one of three thicknesses: .0015, .008, or .016 inch. The differing thicknesses of the sheets provide a means to measure the energies of meteoroids that penetrate them.

There is a film of polymer plastic inside the aluminum sheet. A copper coating is on the other side of the plastic. Forty volts of electrical current flow between the outer aluminum skin and inner copper coating. In effect, the sandwich of aluminum, plastic, and copper is a

capacitor, a device that holds or stores an electrical charge.

This sandwich is mounted on soft foam plastic which in turn is laid on a rigid foam plastic center core. On the other side of this core is another layer of soft foam plastic and, outward, in turn, layers of copper, polymer plastic, and aluminum sheet which form another capacitor with a 40-volt electrical charge.

When a meteoroid punctures the aluminum foil, its impact vaporizes both the foil and itself. This is due to the velocity of impact which is many thousands of miles per hour. The energy released by the impact is so great that electrons are stripped from the vapor (gas) atoms.

Removal of the negatively charged electrons unbalances the neutral gas atoms, giving them

positive electrical charges. The atoms are then called ions. The resulting electrically-charged gas, made up of ions and electrons, is called a plasma.

The plasma absorbs the panel's electrical charge (short circuits the panel), but momentarily only as the plasma dissipates almost immediately.

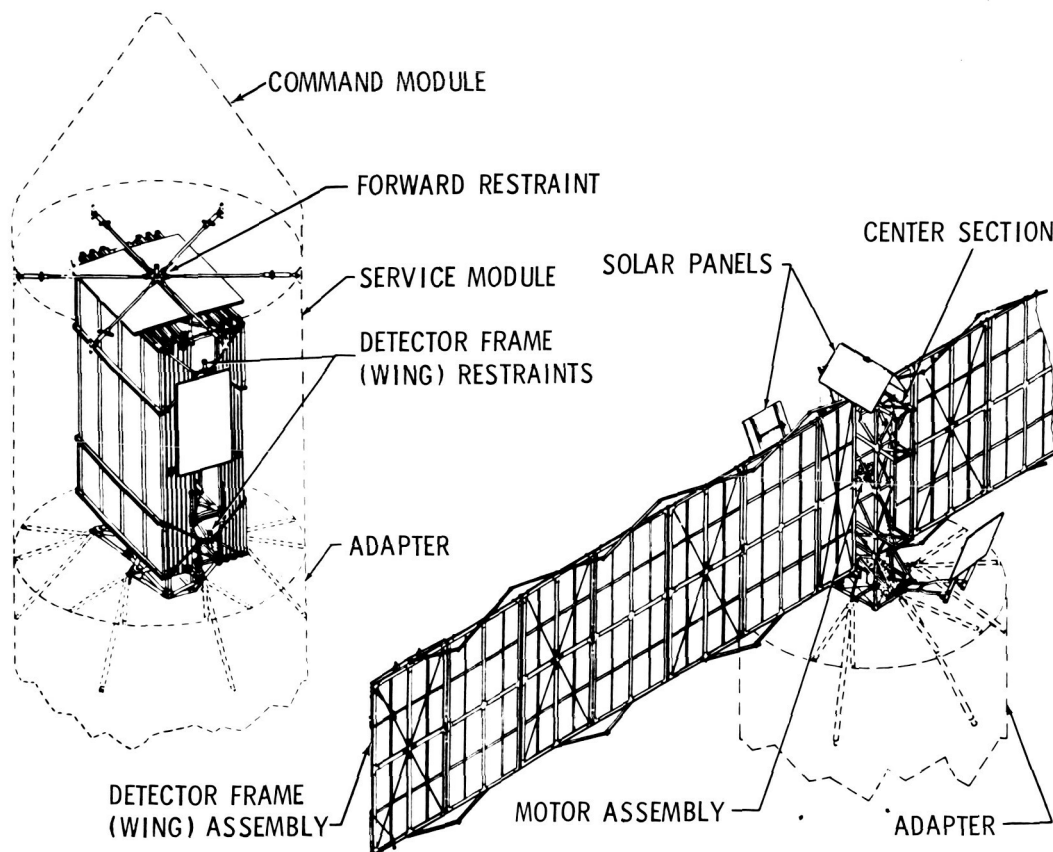
The panel is automatically recharged. The recharge which takes .003 of a second, is recorded by satellite instruments. The instruments correlate the event with such other data as identification of the panel struck, panel thickness, time of penetration, orientation of the satellite at the moment of penetration (by tumbling in space, Pegasus is punctured by meteoroids coming from all directions), and the cumulative number of hits on the panel.

As shown above, each panel has two capacitor-type meteoroid detectors. There are 104 panels on each wing. The 208 panels of both wings thus provide 416 separate meteoroid detectors.

## CENTER AND ADAPTER SECTIONS

The two great wings of Pegasus are attached to the center section which is connected by an adapter section to the spent second stage of the Saturn launch vehicle. The adapter section is equipped with a television system designed to enable ground observers to watch on television screen as Pegasus unfolds its great wings in orbit.

The center section is equipped with the motor that unfolds the wings; solar panels on which are mounted solar cells that convert sunlight to electricity for powering satellite equipment; rechargeable batteries to provide electricity for running Pegasus equipment when the satellite is shadowed by earth and its solar cells, consequently, are not in sunlight; sensors for such uses as determining satellite orientation and temperature; equipment for acquiring and recording space data and transmitting them to earth; and communications and other electronic equipment for monitoring or operating the satellite.



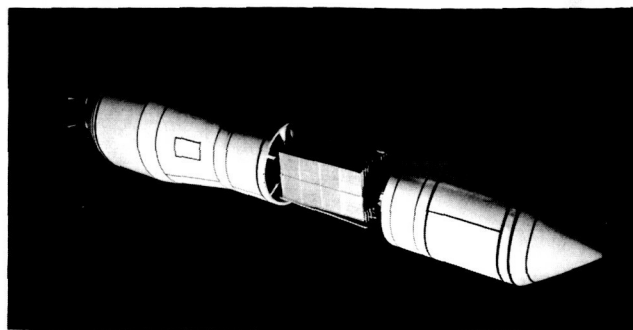
Drawings show Pegasus folded within boilerplate Apollo (left), and unfolded in space. The forward and wing restraints hold Pegasus in place until it is freed from Apollo.



## LAUNCH AND ORBITAL INFORMATION

At launch, the wings of Pegasus are folded like an accordion to fit inside of a specially adapted "boilerplate" of the Apollo service module. Capping the service module is a boilerplate Apollo command module. The two modules enclose and protect Pegasus from launch to orbit.

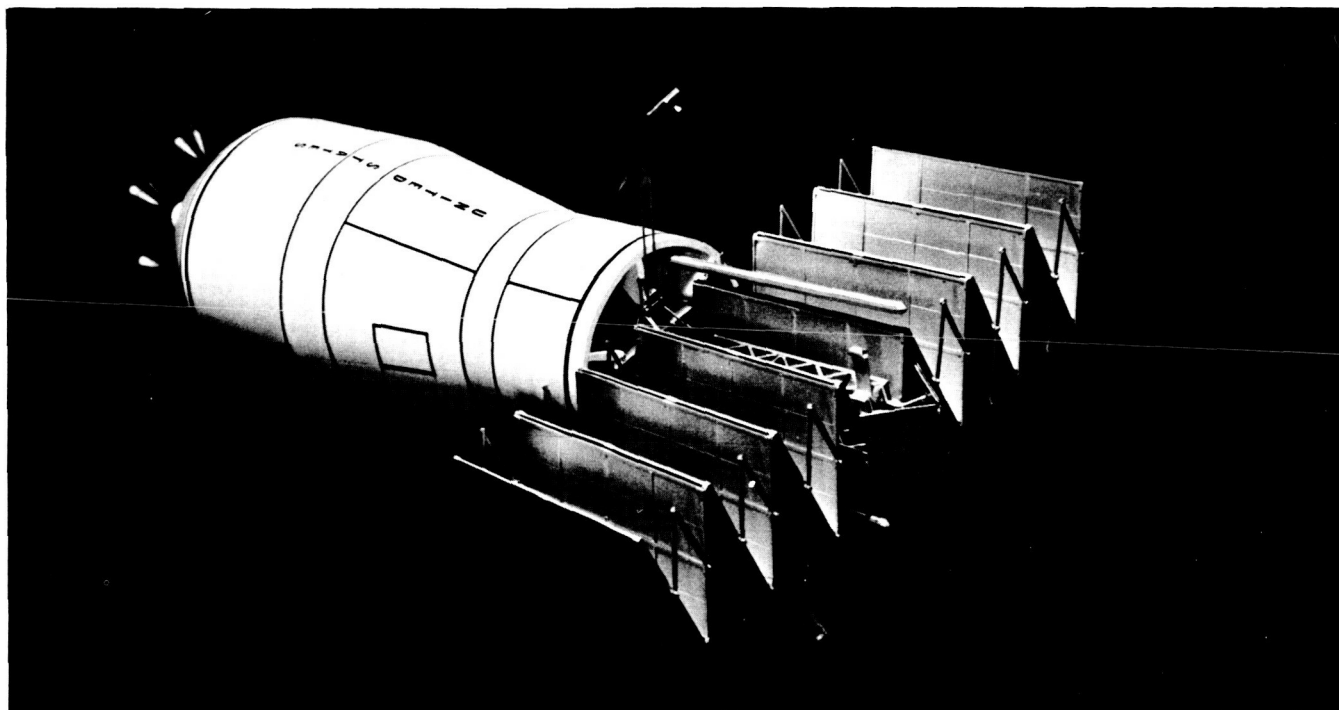
Boilerplates are engineering test models of craft. The Apollo command module is one of three sections of the Apollo spacecraft in which three American astronauts will first journey to the moon. The command module is intended to serve as the control room and living quarters for the trip. The service module, another section of the Apollo spacecraft, will be equipped with rocket engines and fuel tanks, providing the spacecraft with considerable maneuverability. (A third Apollo section, not represented in the Pegasus experiment, is called the lunar excursion module. Two Apollo astronauts will land the lunar excursion module on the moon while the third remains in orbit with the command and service modules. Later, the two astronauts will launch the lunar excursion



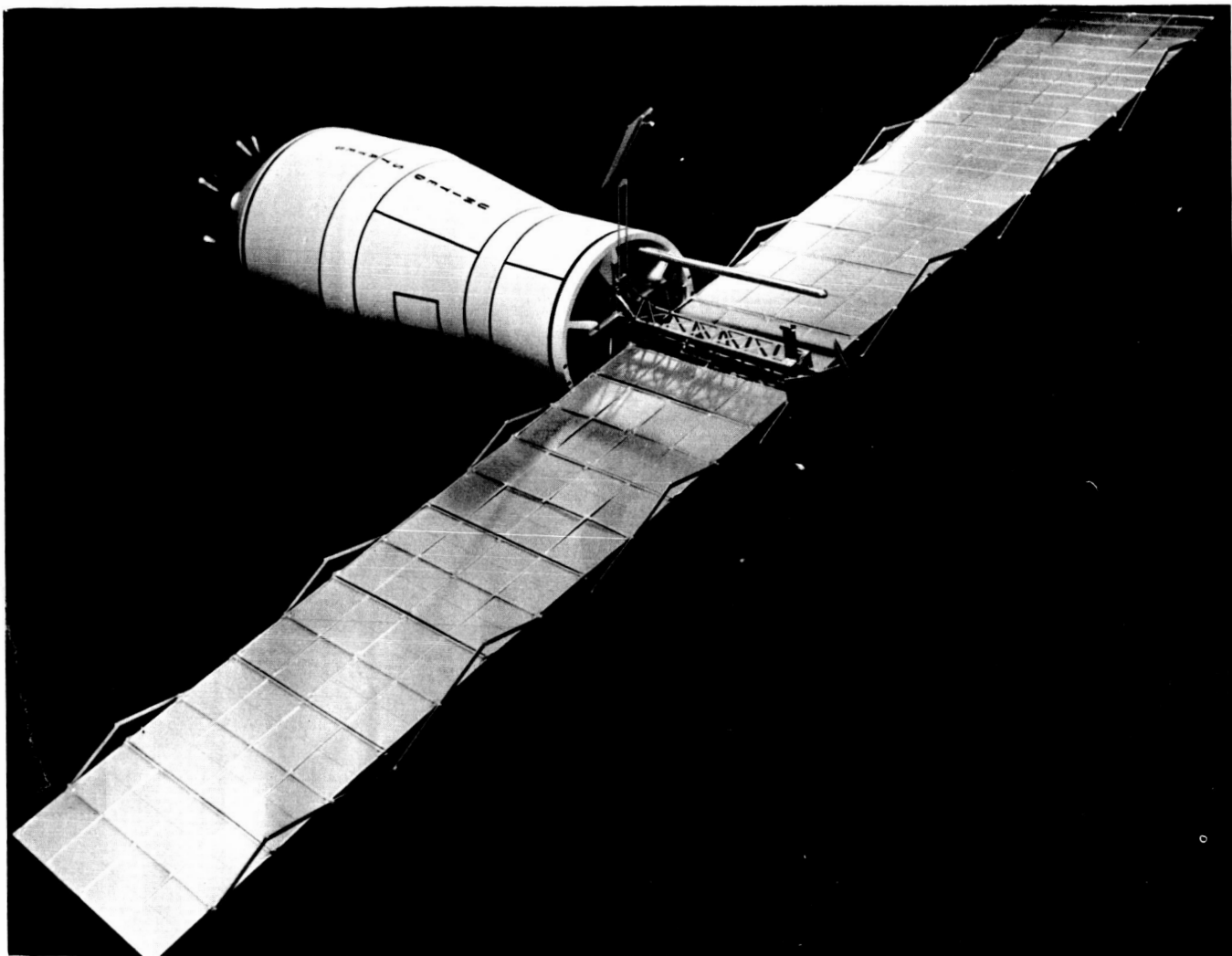
Working model represents second stage of Saturn and Apollo boilerplate with folded Pegasus in place. Service module's shell, which protected satellite during launch, has drifted away, freeing the Pegasus satellite to open its 96-foot long wings.

module from the moon and rejoin the parent Apollo craft in orbit.)

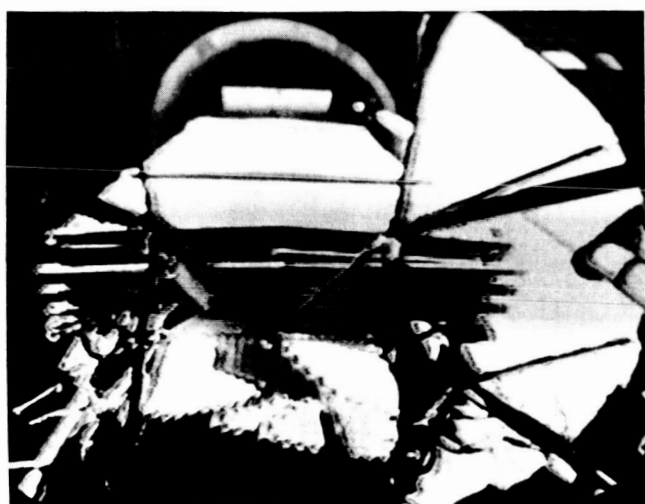
Typical of Pegasus launchings was that of Pegasus I. Pegasus I was launched by the 1.5-million-pound-thrust Saturn I rocket vehicle (see below) from Cape Kennedy, Florida, into an orbit ranging from 308 to 462 miles above earth. In orbit, the shells of the Apollo command and service modules (see diagram Saturn SA-9 vehicle) were detached from the adapter section and, nudged by spring action, rolled forward along guide rails. They rolled off the



Pegasus model begins to unfold. Note also deploying solar panels, bearing the electricity-generating solar cells, above and below the wing and in a "pup-tent" arrangement at forward end.



Pegasus as it would look unfolded in space.



Actual telecast sent to earth by a TV on the Pegasus adapter section shows the Apollo service module moving away from Pegasus in orbit. Circular object in background is rear of Apollo service module.

end of the guide rails and drifted off into space, exposing and freeing Pegasus. Shortly afterward, Pegasus unfolded its wings. Total time from lift-off to complete deployment of Pegasus I in orbit was 17 minutes.

The orbit of Pegasus I is inclined or angled 32 degrees from the equator. The satellite's orbital period, or time for one revolution, is about 97 minutes.

Pegasus is designed to function for a year or more. It is expected to orbit earth for more than three years.

### METEOROID STUDIES

Meteoroids are particles of matter, of varying sizes, in space. In outer space, the objects are called meteoroids. When they head through the

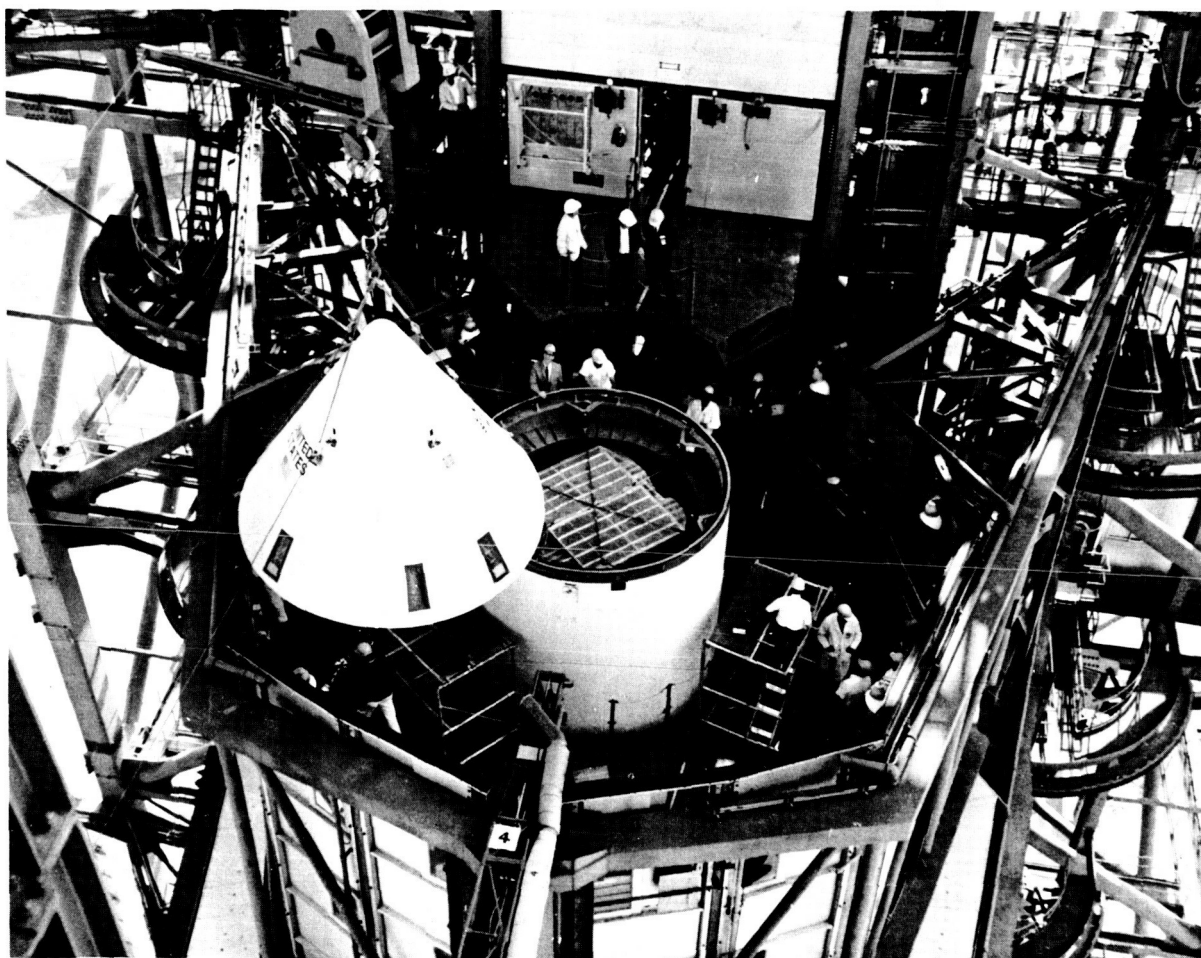
atmosphere toward earth and glow due to atmospheric friction, they are referred to as meteors and sometimes are called "shooting stars." Portions of meteors that survive the fiery trip through the atmosphere to strike earth are termed meteorites.

Studies of these mysterious objects have been carried out by satellites, sounding rockets, interplanetary spacecraft, high-altitude flights of the X-15 research airplane, telescopic and radar observations, and in laboratories. For the most part, meteoroids are smaller than grains of sand. Sizable meteoroids are rare. Laboratory analysis of meteorites has shown that they are composed of elements which also exist on earth.

NASA's Explorer XVI satellite, launched December 16, 1962, provided data showing that tiny meteoroids could pierce thin metal surfaces. This hazard to spacecraft had previously been

presumed but not proved. The frequency of meteoroids and meteors reported in earth's environment appears to vary with different periods of the year. Comparison of meteoroid data from man-made earth satellites and from NASA's Mariners II and IV indicates that meteoroids may be 10,000 times more abundant near earth than along the paths of these craft in interplanetary space. (Mariner II, launched August 27, 1962, flew from earth to the vicinity of Venus. Mariner IV was launched November 28, 1964, on a flight skirting Mars.)

Because of its large size and the broad range of thicknesses of material it presents for meteoroid puncture, Pegasus is expected to contribute significantly to meteoroid knowledge. For example, Explorers XVI and XXIII, the largest of the meteoroid study satellites prior to Pegasus, exposed about 25 square feet of instrumented area to meteoroid bombardment. This is about one-eightieth of that presented by Pegasus.



Overhead view of Pegasus inside of Apollo "boilerplate" service module; Apollo command module moving into place.

In launching Pegasus I, Saturn I placed a total weight of about 33,000 pounds in orbit. Broken down, this includes the 3200-pound wings and center section of Pegasus; the 2700-pound adapter section and its associated supporting structure, the 14,500-pound spent S-IV Saturn second stage; the 2600-pound Instrument Unit; and the approximately 10,000-pound boilerplate Apollo command and service modules. In addition, the S-IV had about 700 pounds of unused propellant when its engines were cut off in orbit. The propellant gradually evaporated in space.

## SATURN I

Pegasus is launched by Saturn I, the Nation's most powerful rocket vehicle. Before the Pegasus experiments, Saturn I flights were part of the rocket's developmental program and launched boilerplate Apollo command and service modules.

In this connection, secondary missions of Pegasus are tests of the jettison of the Apollo launch escape system (LES) and additional experience in and study of Saturn I performance to aid development of the more powerful Saturn IB and Saturn V launch vehicles.

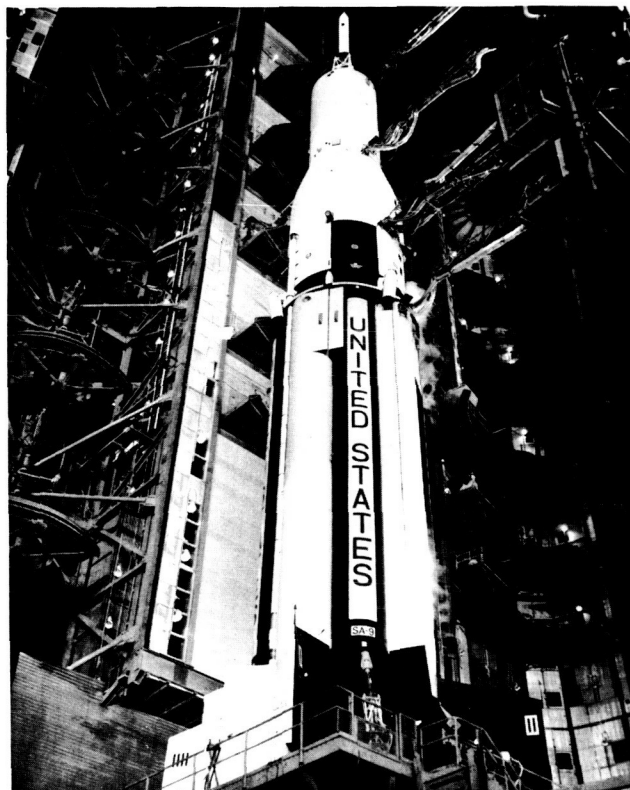
The LES is intended to rocket the manned Apollo craft from the launch vehicle in case of suspected trouble. Plans call for the Saturn IB to be used in Apollo manned orbital flights preparatory for the lunar mission and the Saturn V to rocket the manned Apollo craft to the moon.

Saturn I is made up of three basic sections: the S-I, which is its first stage; the S-IV, which is its second stage; and the Instrument Unit mounted on top of the second stage.

S-I is a cluster of eight H-1 rocket engines burning liquid oxygen and refined kerosene. It generates a total thrust of 1.5 million pounds. S-I is 80.3 feet long and 21.4 feet in diameter. Up-rated in power, it will be used as the first stage for Saturn IB.

The S-IV is a cluster of six RL-10-A-3 engines that utilize liquid oxygen and liquid hydrogen to generate a total thrust of 90,000 pounds. S-IV is 41.5 feet long and 18.5 feet in diameter.

The Instrument Unit contains Saturn's guidance system, power supplies, and equipment by which Saturn can be monitored and tracked from earth. The unit, shaped like a narrow drum, is 34 inches high and 154 inches in diameter.



Saturn I with Pegasus I payload on launch pad at Cape Kennedy, Florida.

The launch of Pegasus satellites is the primary mission of the eighth, ninth, and tenth Saturn I developmental flight tests. These are the last of the series of such tests.

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